Original Article

Noise Levels in Dental Offices and Laboratories in Hamedan, Iran

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Abstract:

Objective: Noise pollution is one of the most important situations requiring a solution by the contemporary world. The National Institute for Occupational Safety and Health has identified noise as one of the ten leading causes of work-related diseases and injuries. Dentists and dental auxiliaries are exposed to different noise levels while working in dental offices or laboratories. The purpose of this study was to measure the noise level made by different dental instruments in dental offices and laboratories.

Materials and Methods: Measurement of the noise level was performed in 89 dental offices and nine dental laboratories. The noise levels were determined using a sound level meter; type SL-4011 (Lutron) ,which was placed at the operator's ear level in dental offices and laboratories and also at two-meter distance from the technician's ear in laboratories.

Results: The maximum sound level was 85.8 dB in dental offices and 92.0 dB in laboratories. In dental clinics, the highest noise was produced by the ultrasonic-scaler (85.8 dB) and the lowest noise (49.7 dB) by the high-volume aspirator, whereas in the laboratory, the highest noise was caused during grinding by the stonecutter (92.0 dB) and the lowest by the denture-polishing unit (41.0 dB).

Conclusion: After close evaluation, we believe that the maximum noise level in dental offices, although often beneath the damaging noise level for the human ear, is very close to the limit of hearing loss (85.0 dB). However, laboratory technicians may be at risk if they choose not to wear ear protection (earplugs or earmuffs).

Key Words: Dental Instruments; Laboratories, Dental; Noise, Occupational

Journal of Dentistry, Tehran University of Medical Sciences, Tehran, Iran (2009; Vol. 6, No.4)

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Received: 13 November 2008
Accepted: 25 March 2009

INTRODUCTION

A sound, agreeable or disagreeable, is a stimulus discerned by the sense of hearing. Disagreeable or undesired sounds are described as noises, which may cause undesirable masking of sounds, may interfere with speech and communication, may produce pain, injury and brief or perpetual loss of hearing [1-4].

It is renowned that high sound levels have adverse effects on extra-auditory systems; namely, physical consequences (quickened pulse, increase in blood pressure, constriction of blood vessels, low productivity) [1-9] and psychical consequences (nervousness, mental fatigue and emotional exacerbation) [1-5]. Exposure to noise levels above 80 dB is associated with these consequences, which depends on the intensity of the noise, distance to the source, total duration of the noise, and the individual's age, physical condition and sensitivity [1,2,5].

Noise or sound intensity, is measured in deci-

Fig 1. Sound level meter

bels (dB). Ten decibels means a sound pressure 10 times greater than zero decibels and 20 decibels, a hundred times greater than zero decibels [10,11]. As a guideline, it should be noted that a 3-decibel noise increase is equivalent to a doubling of sound intensity. Decibel is a logarithmic unit in which simple addition is not attainable: 100 dB + 100 dB = 103 dB [12].

Noise pollution is one of the most important situations requiring a solution by the contemporary world [13]. The National Institute for Occupational Safety and Health has recognized noise as one of the ten leading causes of work-related diseases and injuries [2,14,15].

Dentists and dental auxiliaries are vulnerable to different noise levels while working in dental offices or laboratories [2,13].

The objective of this study was to measure the noise level produced by different dental handpieces and other dental engines in dental offices and laboratories.

MATERIALS AND METHODS

Noise level measurements were performed in 89 dental offices and nine dental laboratories in the city of Hamedan in 2008.

The noise level was measured using sound level meter; Lutron SL-4011, 30-130 dB, Australia (Fig 1). The sound level meter reacts to sounds similar to the human ear and provides an objective reproducible measurement of sound levels [1].

At the dental office, the microphone (sound level meter) was placed at a 15 cm distance from the dentist's ear in order to capture sounds at the intensity they influence the operator's ear. This sound level was believed to be similar to that received by the dental assistant, although the opposite ear (of the operator) would tend to be impacted due to the usual operating positions. Since most of the operators are right-handed, it is obvious that the right ear would be affected more than the opposite ear.

High-speed handpieces, low-speed handpieces, ultrasonic scalars, high-volume aspirators, amalgamators, and background noises were the equipment tested.

The level of the noise was measured while the instrument was at maximum running speed without cutting operations. For measurement of the noise level of the high-volume aspirator, it was recorded when the aspirator was running free.

At dental laboratories, the noise level was measured similarly. The microphone was placed near the technician's ear to simulate the noise intensity reaching the eardrum and another reading was taken two meters away. This was to simulate the person within a two-meter radius of the operator who was also being exposed to the same noise, although decreased in intensity, in a situation where multiple operators exist. In different studies, the microphone was located 6.0 inches [1], 5.0 cm [2] and 30.0 cm [16,17] away from the dentist's (operator's) ear, or 30.0 cm away from the equipment [17]. In addition, other non-technical personnel might be close to noisy operations and could be at risk.

The noise was measured over a 30-second interval and the maximum intensity in decibels

was recorded. The mean of the maxima was determined and the overall highest maximum was recorded. This was repeated at least three times [1].

The location of the air compressor in the dental office and the laboratory was also recorded.

The sound levels measured in dental laboratories were those produced by the procedures mentioned below:

1-Compressed air through a blast nozzle

2-Acrylic special tray grinding using an acrylic-trimming bur

3-Cutting stone casts with a large bur

4-Denture polishing unit in operation using pumice on brush wheels

5-Mixing gypsum using vacuum mixing machine and vibration

6-High-speed lathe with a carbide bur cutting and grinding metal

7-Porcelain grinding by an abrasive wheel in a slow-speed handpiece

8-Sandblasting (aluminum oxide air abrasion) on metal casting

All data collected from the checklist were analyzed using the Statistical Package for Social Sciences (SPSS) version 13 and Microsoft Excel spreadsheet were used for data entry and analysis.

RESULTS

The results of the sound level measurements at the operator's ear level in dental offices are shown in Table 1.

Table 1. Noise level of each device measured (dB) near the operator's ear in dental clinics.

Devices		Min (Max) dB
Back ground noise		20.00 (55.00)
High-volume aspirator		49.70 (61.61)
Ultrasonic-scaler		56.20 (85.80)
High-speed handpieces		62.71 (82.64)
Low-speed handpieces (angled-design)		61.03 (79.62)
Low-speed handpieces (straight)		63.00 (76.80)
Amalgamator	powder	40.50 (75.50)
	capsule	42.50 (75.50)

The results of the sound level measurements taken in the dental laboratories at the technician's ear level and two meters away are tabulated in Table 2. The results (Table 1 and 2) indicated that the maximum sound levels in dental offices and laboratories were 85.8 dB and 92.0 dB, respectively.

In dental clinics, the highest noise was produced by the ultrasonic-scaler (85.8 dB) and the lowest noise (49.7 dB) was created by the high-volume aspirator (Table 1).

The highest noise in laboratories was caused by engines during grinding by the stonecutter (92.0 dB) and the lowest noise by the denture-polishing unit (41.0 dB) (Table 2).

DISCUSSION

Immoderate noise can damage hearing and create physical and psychological nervousness [6-9]. In this study, noise levels of the handpieces and engines used in dental offices and laboratories in Hamedan were measured (Table 1 and 2).

The total noise levels in dental laboratories (Table 1) were much higher than the dental clinics (Table 2). The mean maximum environmental noise level for laboratories was 58.0 dB, compared to the mean maximum value of 55.0 dB for dental clinics. We know the environmental noise level also depends on the number of operators, the time of day, noise from outside the office or laboratory through open windows (crowded streets and traffic) and finally radio and TV in some dental offices or laboratories.

Kilpatrick proposed a number of sounds in the dental office that may be hazardous to the dentists' hearing [18]:

1.High-speed turbine

2.High-volume aspirator

3.Ultrasonic scaler

4.Mixing devices for stone, amalgam and other substances

5.Continuous loud music

The high-speed turbine handpiece was intro-

duced in 1957 and is thought to generate the greatest potentially hazardous sound level [19]. The early models of the ball-bearing type were found to produce noise levels of 80 to 94 decibels at 12 inches [6], the change from ball-bearing to air-bearing handpieces happened in the 1960s. Some studies found that with the advent of air bearings in the drills, the noise level decreased by about 10 decibels [20-22]. A cartridge-type ball-bearing drill from the early 1960's produced a higher noise (8.5 dB) compared to an air-bearing drill or a modern sealed head ball-bearing drill (5.0 dB) [23]. Subsequently, return of ball-bearing handpieces took place. Presently, manufacturers claim that most handpieces produce less than 75 decibels noise. Recuperated design and air exhaustion have resulted in quieter instruments than before [19].

In this study the maximum noise level were respectively, low-speed straight handpiece (76.8 dB), low-speed angle handpiece (79.6 dB) and the high-speed turbine angle handpiece (82.6 dB) was increased. This is concordant with antecedent studies mentioning that the high-speed turbine handpiece generates a higher noise level than the low-speed handpiece [6,18,2]. Sound pressure levels of the noise created by the dental drill ranged from maximum 61.0 dB to max 82.0 dB, which is almost within safe limits [23]. It was concluded that the risk of damage to the dentists' hearing due to dental turbine noise is insignificant.

There are several opinions regarding the effects of dental drill noise and other noises on dentists' hearing. Some found that a considerable loss of hearing results from noise problems in dental practice [1,20,24], whereas others have found no significant shifts in auditory thresholds [1,25,26].

The first convincing evidence proving that damage to hearing may be caused by exposure to noise produced by a dental drill was published by Taylor et al [20] in a carefully controlled study of dentists in Dundee, Scotland.

According to reports from the Occupational Safety and Health Administration, eight hours of perpetual exposure to a noise level of 90.0 dB is permissible daily [27]. On the report of the noise pollution control act in Iran, workers may be exposed to a maximum noise level of 85.0 dB for eight hours without ear protection.

Based on the overall measurements in this study and other comparable studies [6,18,28], we found that the amount of noise dental practitioners are exposed to is still below the limit of the risk of hearing loss (85.0 dB). Forman-Franco et al [29] found no statistical decrease in the hearing thresholds of 70 dentists when they were compared with a normal, age-adjusted population. However, dental technicians who spend daily eight hours in large laboratories should also be considered at risk.

In dental offices and laboratories, regular maintenance of the equipment, early repairs,

Table 2. Noise level (dB) measured near the operator's ear (I) and at two-meter distance (II) in dental laboratories.

Devices	I		II	
	Min (Max) dB	Mean (SD)	Min (Max)	Mean (SD)
Compressed air	82 (85)	83.5 (2.12)	82 (82)	82.0 (0.0)
Special tray grinding	70 (85)	77.8 (5.60)	62 (78)	68.6 (6.3)
Stone cutter (grinder)	75 (92)	82.0 (5.00)	70 (89)	75.0 (6.7)
Denture polishing unit	48 (75)	63.2 (10.00)	41 (63)	56.0 (8.8)
Stone mixer (with vibrator and vacuum)	58 (76)	66.0 (6.70)	51 (73)	61.0 (7.6)
Metal cutting	71 (82)	78.2 (4.00)	62 (75)	70.0 (5.2)
Porcelain grinding	73 (80)	76.0 (3.60)	60 (73)	67.2 (5.9)
Sandblaster	52 (79)	70.3 (8.70)	57 (66)	61.7 (3.0)
Background noise	34 (58)	45.88 (9.34)	34 (58)	45.88 (9.34)

replacement of defective items, use of newer less noisier models and increasing sound absorption of the room (by 3-5 dB) may have a 4-7 dB decrease in the noise level, consequently preventing noise-induced hearing loss [5]. The operating room should be made more acoustically satisfactory by minimizing the hard surfaces that allow reverberation of sound [1].

It is, therefore, essential to control noise in dental environments, emphasizing the fact that acoustic comfort depends not only on control of emitted sound levels, but also on the acoustic characteristics of the place (hard surfaces act as noise reflectors, therefore aggravate sound) [5].

Periodic audiometric checkups should be carried out. When you know you will be exposed to loud noises, either temporarily or over a longer period, using ear plugs or ear muffs may help prevent hearing loss. Properly fitted earplugs into the outer ear canal and earmuffs placed over the entire ear decrease the intensity of the sound reaching the eardrum by 15 to 30 decibels when used separately, and if used together reduce the noise by 30.0 to 35.0 dB without interfering with the conduct of a normal between-person conversation in the laboratory [1].

CONCLUSION

After close evaluation, we believe that the maximum noise level in dental offices, although often beneath the damaging noise level for the human ear, is very close to the limit of hearing loss (85.0 dB). However, technicians may be at risk if they do not wear ear protection, because properly fitted earplugs and earmuffs can reduce noise by 15 to 30 decibels.

ACKNOWLEDGMENTS

This work was supported by a grant from Hamedan University of Medical Sciences (No. 470). We wish to thank the Department of Occupational Health, School of Public Health for their valuable comments. The authors declare that they have no conflict of interest.

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